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ABSTRACT

Achievement in Mathematics (AIM), an algebra class at Lexington Community College, has successfully demonstrated the benefits of collaborative study. Six sections of Intermediate Algebra were taught by three instructors, each teaching one traditional section and one collaborative section. All six sections were given the same lectures, tests, and homework, but the collaborative sections, which consisted of student volunteers, attended an additional two-hour workshop where they worked in small groups on supplementary homework problems. The Math ACT scores of the traditional and collaborative groups were nearly identical, as were the gender and other standard indicators. Collaborative sections achieved higher grades and had higher passing rates than did the traditional groups in both Intermediate and College Algebra, though the latter was not collaborative. AIM was modeled after an equally successful course called MathExcel, a calculus program in Kentucky that combined workshops and a personal atmosphere with interested students, dedicated faculty, and assessment. Collaborative programs also exist on the Lexington Campus of the University of Kentucky (UK) and in the UK Community College System. The program has proved to be cost effective due to the savings resulting from a larger rate of student success after only one academic attempt. (YKH)

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Math and Science on a Personal Level

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Math and Science on a *Personal* Level

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APPALACHIAN RURAL SYSTEMIC INITIATIVE
A program of the National Science Foundation

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The Collaborative Advantage.

The best algebra class at Lexington Community College is a group of about seventy volunteer students who are making spectacular use of collaborative study. It is called Achievement in Mathematics (AIM), and this is how they did from Fall 1994 through Spring 1996 compared to a control group receiving traditional instruction.

4 Semesters of Intermediate Algebra F '94 - S '96	Traditional Sections	Collaborative Sections
Grade	1.5	**2.4**
Pass rate	31%	**49%**
MACT score	16.5	16.4
No. of Students	331	253

Three Instructors taught 6 sections of Intermediate Algebra. Each teacher was assigned a traditional section and a collaborative section. All 6 sections were given the same lectures, tests and homework. The Collaborative sections attended an additional 2 hour Workshop, in which they worked in small groups on problem sets supplementary to homework and somewhat more challenging than homework or tests. Most of the Collaborative students were volunteers who had responded to an aggressive pre-semester recruiting and publicity effort, so there were only a few last minute walk-ons. Note that the number of students is large enough to make a fluke unlikely, and that *the Math ACT scores of the two groups are nearly identical*. So were the gender makeup and other standard indicators.

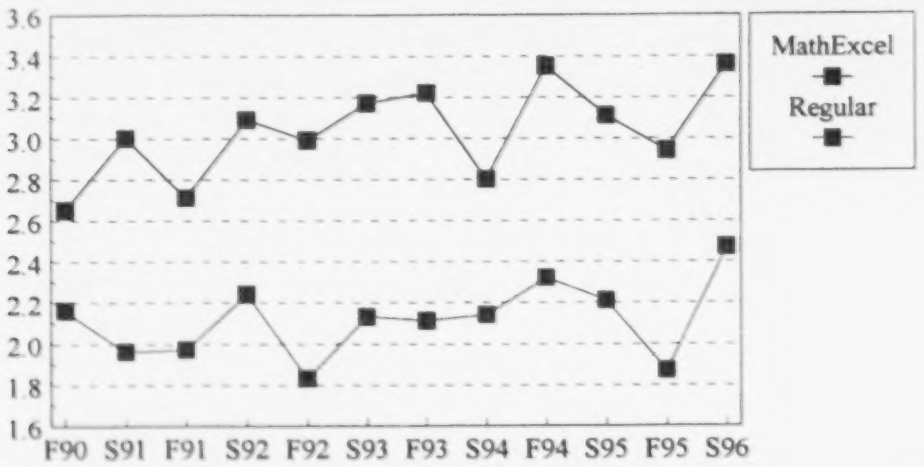
ARSI, The Appalachian Rural Systemic Initiative, is stimulating and supporting adaptations of this program in community colleges serving 66 Appalachian counties.

These results are stunning, and *they persist*. Students from each group have gone on to College Algebra, with these results.

4 Semesters of College Algebra S '95-F'96	Traditional Sections	Collaborative Sections
Grade	1.5	**2.4**
Pass Rate	51%	**82%**
MACT score	18.3	18.1
No. of Students	65	78

College Algebra, the sequel to Intermediate Algebra, had no special collaborative opportunities and the three Intermediate Algebra instructors were not involved. Note that the Math ACT scores of the two groups are again nearly identical.

The Achievement in Mathematics Program is an adaptation of MathExcel, a calculus program in operation at the University of Kentucky since 1990. MathExcel has also inspired counterparts at UK in Chemistry, Physics, and Biology: ChemExcel and PhysExcel began in Fall 1995, and BioExcel began in Spring 1997. MathExcel has inspired a Calculus program at Eastern Kentucky University begun in Spring 1995 called MathExcel at EKU. MathExcel has a seven year record of success at UK. This is how MathExcel students compare with traditional ones:



In six of the seven semesters since Fall 1992 the advantage has been a margin of more than 1 grade point. The table below shows that since Fall 1994 MathExcel students have made almost twice as many A's and B's and their withdrawal and failure rate has been comparatively negligible. Only a very few of the almost 600 MathExcel students have withdrawn since the Program started in Fall 1990. Note again that *MathExcel students do not have exceptional natural ability*: their average math ACT score is within two points of the traditional class.

Comparative Results 1994-96	Fall 1994 Calculus I		Spring 1995 Calculus II		Fall 1995 Calculus I		Spring 1996 Calculus II	
	MathExcel (57)	Regular (396)	**MathExcel** (57)	Regular (396)	**MathExcel** (68)	Regular (236)	**MathExcel** (50)	Regular (68)
Average Grade	**3.35**	2.33	**3.17**	2.21	**2.94**	1.87	**3.36**	2.47
% A's or B's	**86.2**	47.1	**76.4**	43.5	**60.0**	35.2	**84.0**	53.3
% Withdrawing or Failing	**5.2**	24.9	**9.1**	28.4	**16.0**	38.2	**2.0**	19.5
Math ACT score	27.7	26.1	27.7	27.2	26.6	25.9	27.8	25.9

MathExcel students are also volunteers who have responded to an aggressive recruitment program that reaches all Kentucky high schools and entails a personal interview with the Director.

Four Essentials.

All of these programs have the following critically important features in common.

- **Collaborative Workshops and a Personal Atmosphere**. The Workshop is adjunct to a standard class. Workshop problems are supplementary to homework, and somewhat more challenging. The Workshop is relatively small, not more than 25, and richly supplied with instructional resources: it is led by a specially selected and trained staff member, supported by one or more paid undergraduate Assistants. They constantly foster a feeling of community and a strongly personal atmosphere. The Workshop is longer than one hour—two is ideal. It is non-judgemental and carries pass/fail credit. It is informal, often noisy, intense, and very constructive.

- **Good Students**. This means they are motivated, hard-working, and interested in cooperative study. They are capable, but not necessarily extraordinary talented. These students are attracted by an energetic and *continuing* publicity and recruitment effort.

- **Dedicated Faculty Leadership,** with time to do the job right. The elements of success are time-consuming, and formal release time is necessary. More time will be required at start-up, and some will be necessary on a *continuing* basis.

- **Assessment**. Traditional sections of the same class serve as a credible control by means of standard tests and objective grading methods. Records are kept to verify long term results.

ARSI is supporting the initiation of programs with these features in the community colleges serving 66 designated Appalachian counties, by negotiating seed grants to promising institutions. Six such programs have begun during the academic year 1996-97 in Tennessee, Kentucky, Ohio, and West Virginia. The principal component of these grant budgets is faculty release time, shared with the recipient institution.

The Benefits.

- **Fun, and lots of it** is in store for everyone involved. This is no small benefit. Real joy in educational activity is not as common as we would like, and here is a situation which promotes it.

- **You will make a real difference.** MathExcel students exhibit significantly greater retention in the University at every stage of their academic careers. This retention benefit is appearing in MathExcel at UK, and has been verified by a recent scientific study of the more mature program at Cal Poly in Pomona.

- **Recognition.** These programs play very well in the community, and teacher's groups are especially supportive. Institutions running them are rightly proud. MathExcel at UK is recognized as one of the best programs of the more than one hundred like it in the country. The UK Community College System supports its Achievement in Mathematics program, and is extending it to other campuses in the System.

- **Dissemination of Collaborative Instruction.** Collaborative study is becoming more widely adopted as a mode of instruction, and formal cooperation in the workplace is an established trend in business and industry. These programs are a powerful and attractive demonstration of the effectiveness of collaborative effort. Academics are notoriously conservative, but faculty in departments sponsoring successful programs of this type are being drawn to them and moved to propose their own curricular initiatives for collaborative study.

• **Enrichment of your professional atmosphere.** These programs enrich and energize a department. There is immense satisfaction in helping students make such effective use of the virtues of cooperative effort and hard work. We are continually gratified by how all associated with such a program rise to its opportunities. The structure seems to bring out the best in everyone.

The Goal.

ARSI seeks to make a permanent impression on participating institutions, by seeing a successful program continued under full institutional support, or the incorporation of its elements into standard curricula.

This goal is being realized on the Lexington Campus of UK and in the UK Community College System.

• University of Kentucky math faculty not directly involved with MathExcel have initiated a reform of the standard calculus sequence which, quoting the UK Dean of Arts and Sciences "heeds the lessons of MathExcel". Some are adopting collaborative methods in their own courses, after visiting MathExcel Workshops and observing MathExcel students in their calculus lectures.

• The UK Community College System recently adopted a new 4 credit Intermediate Algebra course whose scheduling is designed to encourage collaborative activities. It is a system wide reform inspired in part by the AIM Program at LCC.

Expenses, Funding, and Support.

The premium for offering such a program is mainly the cost of faculty release time. This is necessary to provide time for recruitment, publicity, active cooperation with the institution's infrastructure, personal attention to students, collection and maintenance of data, and reflection. Funds are also needed to pay Undergraduate Assistants and to support travel and office expense of recruiting and publicity activities. However, the relatively lavish expense per student is offset by savings which result from the much larger rate of success at the first try. A student making repeated attempts to pass uses up resources. In fact, the study of the program at Cal Poly actually demonstrated it to be *cost effective* for this reason.

Curriculum materials are widely available, so it is unlikely that explicit support for their preparation will be needed. Thus the Achievement in Mathematics Program makes their Workshop Problem Sets freely available, and so will the Appalachian Community Colleges under ARSI sponsorship.

ARSI will sponsor site visits to the programs in operation in Lexington, conduct Workshops to train the leadership of funded programs, encourage the establishment of a network of such leaders and administrators, sponsor meetings, and maintain easy access to the resources of experienced leadership in and around Lexington.

The Appalachian Rural Systemic Initiative is a project of the National Science Foundation. The purview of ARSI is a group of 66 Appalachian[1] counties in Kentucky, West Virginia, Ohio, Virginia, North Carolina, and Tennessee. This summary is intended to excite interest from community colleges which serve students from those counties.

[1]These are Appalachian counties in which at least 30% of school-age children live in poverty.